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# RELATIVE AVERAGE RECRUITING YIELDS BY AFQT CATEGORY

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# RELATIVE AVERAGE RECRUITING YIELDS BY AFQT CATEGORY

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**ABSTRACT**

The number of recruits enlisted from a target population varies significantly by aptitude score. This memorandum calculates the ratio of recruits to population by AFQT category for the fiscal years 1980 to 1987.

## EXECUTIVE SUMMARY

Each year the armed services recruit several hundred thousand new personnel. Enlistment standards for these personnel are established in terms of mental aptitudes as measured by the Armed Forces Qualification Test (AFQT), which is constructed from the Armed Services Vocational Aptitude Battery (ASVAB). Estimates of the costs of recruiting as a function of fine-grained intervals of ASVAB scores are frequently needed, as is the case for the congressionally directed joint-service Job Performance Measurement project. The goal of this project is to set cost-effective enlistment standards. Cost estimates are currently available only in terms of very large intervals of ASVAB scores.

This research memorandum develops a methodology for calculating relative recruit yields for intervals of AFQT scores. *Recruit yield*, in this context, is defined as the proportion of a population that enlists when recruiting effort is undifferentiated. Although this approach does not directly provide estimates of recruiting costs for different AFQT categories, it does provide useful information on the recruit yields from different mental groups of an undifferentiated recruiting effort. The procedure is illustrated by applying it to readily available data for individual AFQT categories. If the method proves useful it can easily be applied to smaller score intervals.

The fundamental assumption underlying the analysis is that the recruiting effort is undifferentiated--that is, that there is an aptitude level at and above which recruiters of at least some services are indifferent to the aptitude level of the recruit. This aptitude level may vary from year to year.

The data used in this analysis are on male high-school-graduate (and senior) applicants and accessions from all military services within the Department of Defense during fiscal year (FY) 1980 through FY 1987. The 1980 ASVAB Reference Population data set was used to establish the target population base.

### RESULTS

The assumption of an undifferentiated recruiting effort appears to hold, and the method is deemed appropriate for use in AFQT category IIIB and above for recent years and in AFQT category IVA in FY 1980. Results could probably be calculated in aptitude intervals as small as 10 percentile points and might be extended to AFQT category IVB.

Estimates of relative average DOD recruiting yields for male high school graduates by AFQT category are shown in table I and may be summarized as follows:

- Individuals with aptitude slightly above the mean (category IIIA) or slightly below the mean (category IIIB) of the population have about the same recruiting yield.

- Individuals with aptitude about one standard deviation above the mean (category II) have a yield about 30 percent lower than that at the mean.
- Individuals with aptitude about one standard deviation below the mean (category IVA) have a 60-percent higher yield than that at the mean.
- The yield drops sharply at high aptitudes; the enlistment rate for category I is about 70 percent lower than that at the mean.

Table I. Relative average DOD recruiting yields by recruit aptitude level

| AFQT category | AFQT percentile Range | AFQT percentile Mean | Standard deviation of mean percentile from population mean[a] | Relative average recruiting yield |
|---|---|---|---|---|
| I | 93-99 | 96.5 | +1.6 | 0.31 |
| II | 65-92 | 79.5 | +1.0 | 0.70 |
| IIIA | 50-64 | 57.0 | +0.2 | 1.00 |
| IIIB | 31-49 | 40.0 | -0.3 | 1.05 |
| IVA | 21-30 | 25.0 | -0.8 | 1.61 |

a. (Mean AFQT percentile - 50.0)/28.9.

CONTENTS


| | Page |
|---|---|
| Tables | ix |
| Introduction | 1 |
| Data | 2 |
| Assumptions | 2 |
| Results | 6 |
| Extension of the Results | 9 |
| References | 11 |
| Appendix A: Supplemental Data | A-1 |

## TABLES


| | | Page |
|---|---|---|
| 1 | AFQT Categories | 2 |
| 2 | DOD Accessions, Applicants, and Population of Male High School Graduates by AFQT Category | 3 |
| 3 | Ratio of Applicants to Population by AFQT Category, All Services | 5 |
| 4 | Ratio of DOD Accessions to Applicants by AFQT Category | 6 |
| 5 | Ratio of DOD Accessions to Population by AFQT Category | 7 |
| 6 | Relative Average DOD Recruiting Yields by AFQT Category and Year | 7 |
| 7 | Relative Average Recruiting Yield by Recruit Aptitude Level | 8 |

## INTRODUCTION

All services are currently involved in a congressionally directed joint-service project aimed at linking military enlistment standards to on-the-job performance and, through this linkage, setting cost-effective standards. As used here, the term *enlistment standards* generally refers to scores on the Armed Services Vocational Aptitude Battery (ASVAB) and the Armed Forces Qualification Test (AFQT) score, derived from the ASVAB.

To address the performance aspect of the project, extensive hands-on tests of job performance are being built and administered to recruits. Analyses of the resulting data will yield the relationship between ASVAB scores and job performance.

Performance, however, is only part of the issue. It is well known that recruits with higher aptitudes will perform better, but is the better performance worth the presumed extra cost of recruiting and retaining these recruits? In a pioneering effort to explore this issue, the RAND Corporation developed a cost-benefit model [1, 2] for use by the joint-service project. Alternative models have also been examined [3]. For maximum effectiveness these models require a well-defined relationship between the ASVAB scores of individual recruits and the costs of recruiting, training, maintaining, and retaining them.

This research memorandum addresses the issue of the relationship between AFQT scores and the number of accessions for a given population. Previous efforts in this area [4,5,6] have tended to be cross sectional or time-series econometric analyses of high-level aggregations of recruits (i.e., high school graduates or upper AFQT categories). The job performance project, on the other hand, needs recruiting costs delineated for very small intervals of AFQT scores. Although recruiting costs are not directly estimated in this memorandum, calculating relative yields of recruiting provides important information on the relative yields from different AFQT groups.

A method that should enable average recruiting yields to be estimated in very small intervals of AFQT scores is proposed here. The procedure is illustrated by applying it to readily available data for individual AFQT categories (table 1). If the method proves useful it can easily be applied to smaller score intervals.

The fundamental assumption underlying the analysis is that each year the recruiting effort made on the youth population is undifferentiated above a certain recruit aptitude level. Above that aptitude level the recruiters of at least some of the armed services are indifferent to the specific aptitude level of the recruit. It follows that the recruiting product (number of recruits per unit of target population) per AFQT interval is inversely proportional to the average recruiting effort (cost) for that AFQT interval. Analysis of data from

1980 shows that an undifferentiated effort can be assumed for male high school graduates at or above AFQT category IVA. Further analysis could probably extend the coverage to include AFQT category IVB.

Table 1. AFQT categories

| AFQT category | Range of percentile score |
|---|---|
| I | 93-100 |
| II | 65-92 |
| IIIA | 50-64 |
| IIIB | 31-49 |
| IVA | 21-30 |
| IVB | 16-20 |
| IVC | 10-15 |
| V | 0-9 |

## DATA

The data used in this analysis are shown in table 2. The numbers of male high school graduates (HSG) and high school senior (HSSR) applicants and accessions from 1980 through 1987 were developed from disaggregated data supplied by the Defense Manpower Data Center (DMDC). Data on the number of male high school graduates[1] age 17 to 21 in the population was calculated from the 1980 ASVAB Reference Population[2] data set [7]. Note that these scores have been correctly renormed, when appropriate.

## ASSUMPTIONS

The fundamental problem is to identify an aptitude level at or above which recruiters' effort to recruit individuals is undifferentiated. Recruiting effort may be considered to be of two kinds: the effort to get individuals to apply for enlistment, and the effort to turn applicants into accessions. These two kinds of effort are explored in turn.

With regard to effort of the first kind, it is reasonable to assume *a priori* that an undifferentiated effort extends into fairly low aptitude levels. Before individuals apply for enlistment and subsequent

1. High school seniors were selected on the basis of high school status at time of testing with ASVAB (survey question 4 in reference 7).
2. The sample size is 1,762 cases. The distribution of aptitudes seems reasonably stable (see appendix A).

**Table 2.** DOD accessions, applicants, and population of male high school graduates by AFQT category

| AFQT category | Fiscal year | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1980[a] | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| | | | | Accessions[b,c] | | | | |
| I | 12,606 | 7,428 | 7,526 | 8,642 | 9,534 | 11,001 | 9,518 | 10,911 |
| II | 45,844 | 65,825 | 71,301 | 78,181 | 84,588 | 70,753 | 77,249 | 77,557 |
| IIIA | 31,970 | 39,010 | 40,272 | 45,881 | 51,197 | 44,227 | 49,760 | 50,569 |
| IIIB | 38,015 | 46,996 | 50,348 | 55,012 | 61,592 | 68,901 | 78,714 | 65,477 |
| IVA | 23,852 | 26,019 | 22,720 | 17,475 | 18,085 | 17,014 | 12,004 | 10,317 |
| IVB/C | 26,041 | 14,699 | 7,973 | 2,737 | 245 | 163 | 37 | 32 |
| | | | | Applicants[b,c] | | | | |
| I | 25,571 | 13,302 | 16,432 | 17,124 | 14,195 | 13,570 | 16,049 | 17,370 |
| II | 87,498 | 118,938 | 139,061 | 142,035 | 114,347 | 105,328 | 115,379 | 114,790 |
| IIIA | 57,827 | 63,834 | 73,381 | 76,345 | 62,041 | 61,174 | 65,745 | 66,574 |
| IIIB | 66,298 | 78,247 | 89,134 | 88,715 | 77,799 | 91,671 | 88,658 | 87,679 |
| IVA | 40,832 | 49,025 | 49,751 | 42,124 | 37,927 | 37,429 | 32,262 | 32,341 |
| IVB/C | 51,519 | 56,225 | 48,922 | 35,697 | 32,892 | 26,926 | 21,621 | 21,304 |
| V | 18,807 | 20,766 | 12,834 | 6,938 | 6,199 | 7,276 | 5,248 | 4,772 |
| | 1980 reference population, ages 17-21 | | | | | | | |
| I | 605,562 | | | | | | | |
| II | 2,032,861 | | | | | | | |
| IIIA | 890,358 | | | | | | | |
| IIIB | 1,084,089 | | | | | | | |
| IVA | 411,335 | | | | | | | |
| IVB/C | 459,076 | | | | | | | |
| V | 259,405 | | | | | | | |

a. Correctly normed scores.
b. Includes individuals who were high school seniors at the time of application.
c. ASVAB scores prior to FY 1985 are expressed in terms of the 1944 reference population. Scores in FY 1985 and later are expressed in terms of the 1980 reference population. The differences are minor and are ignored in this analysis.

subsequent ASVAB testing, the recruiter will generally have only crude information about their ability.[1] This information might include grades in high school, scores on a screening test, and personal impressions. Based on such information, it is difficult to reliably predict whether a prospect is in one or the other of any two adjacent AFQT categories. An individual estimated to be in category IVA might really be in IIIB and would be lost as a recruit if not encouraged to apply.[2] Recruiters have equal difficulty judging whether an individual falls into one or the other of the adjacent categories IIIB and IIIA. On the other hand, most recruiters probably learn quickly to identify persons with very low aptitude, perhaps category V, and do not waste further effort on them. The difficulty lies in judging where the break occurs.

Data on the ratio of applicants to population by AFQT category should help quantify the break point. It is reasonable to expect that the ratio of applicants to population in any year should increase as the aptitude (and thus options) of the potential applicant decreases. On the other hand, if recruiters discourage individuals below a certain aptitude from applying, then the trend should reverse. In table 3, the actual tabulated ratios are presented, and the outcome is as expected. For example, in 1987 a ratio of 2.9 percent in category I increases to 8.1 percent in category IIIB, reverses to 7.9 percent in category IVA, and then declines smoothly to 1.8 percent in category V.

Similar trends characterize the other years. Fiscal year 1980 is particularly worthy, in that the trend holds through category IVB/C and only reverses in category V. FY 1980 was unusual because a misnormed ASVAB [8, 9] was used from 1976 through 1980 so that the information the recruiters had about the aptitude of individuals both before and after ASVAB testing was inaccurate. The misnormed ASVAB overestimated aptitudes so that many individuals who were thought to be in category IIIA were actually in IIIB, many thought to be in IIIB were actually in IVA, and so on. Prior experience as well as screening tests tied to the misnormed ASVAB would, of course, yield the same misleading expectations. As a result many who would have been discouraged from applying were in fact encouraged. The data in table 3 suggest that only applicants actually in category V were actively discouraged from applying.

Categories in table 3 that show declining ratios are assumed to denote aptitude levels at which some applicants were discouraged from applying; hence, they are excluded from our final analysis.

---

1. A small percentage of applicants (5 to 15 percent) will have been tested earlier on the version of ASVAB used in high schools. For these individuals, recruiters will have good aptitude information.
2. Generally limits are set on the number of category IVA applicants that may be accepted for enlistment. No category V applicants are accepted.

Table 3. Ratio of applicants[a] to population by AFQT category, all services

| AFQT category | Fiscal year 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|---|---|---|
| I | .042[b] | .022 | .027 | .028 | .023 | .022 | .027 | .029 |
| II | .043 | .059 | .068 | .070 | .056 | .052 | .057 | .056 |
| IIIA | .065 | .072 | .082 | .086 | .070 | .069 | .074 | .075 |
| IIIB | .061 | .072 | .082 | .082 | .072 | .085 | .082 | .081 |
| IVA | .099 | .119 | .121 | .102 | .092 | .091 | .078[c] | .079[c] |
| IVB/C | .112 | .122 | .107[c] | .078[c] | .072[c] | .059[c] | .047[c] | .046[c] |
| V | .073[c] | .080[c] | .049[c] | .027[c] | .023[c] | .028[c] | .020[c] | .018[c] |

a. HSG/HSSR only.
b. Probable anomalous result due to poorly determined AFQT conversion table for ASVAB forms 6 and 7 in the upper percentiles [8].
c. The declining ratio is taken as an indication that individuals in that category were not actively recruited.

The second kind of recruiting effort is convincing an applicant who has tested on ASVAB to enlist. Here the general expectation is that the ratio of accessions to applicants should increase as aptitude decreases (less options available to applicant) up to the point at which the aptitude is below the minimum standards or is in a category in which only a limited number of recruits are accepted. The ratios, as shown in table 4, generally conform to expectations.

For example, in 1980 the ratio of 0.49 for AFQT category I increases slowly to 0.58 in category IVA before decreasing slightly to 0.51 in category IVB/C and to zero in category V. This result is interpreted to indicate that in 1980 an undifferentiated recruiting effort was expended on persons in AFQT category IVA or higher.[1]

The data for more recent years support the assumption of an undifferentiated effort for category IIIB and above. This result does not imply that all services actively seek category IIIB personnel--only that some do. Categories for which the assumption does not seem to hold are noted in table 4 and are excluded from further analysis.

1. The actual extent of the misnorming was such that an undifferentiated effort may well have extended to category IVB. Individuals thought to be in category IIIB (31st percentile) were actually in category IVB with true percentile scores of 17.

Table 4. Ratio of DOD accessions[a,b] to applicants by AFQT category

| AFQT category | Fiscal year 980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|---|---|---|
| I | .49 | .56 | .46 | .50 | .67 | .81 | .59 | .63 |
| II | .52 | .55 | .51 | .55 | .74 | .67 | .67 | .68 |
| IIIA | .55 | .61 | .55 | .60 | .83 | .72 | .76 | .76 |
| IIIB | .57 | .61 | .56 | .62 | .79 | .75 | .89 | .75 |
| IVA | .58 | .53[c] | .46[c] | .41[c] | .48[c] | .45[c] | .37[c] | .32[c] |
| IVB/C | .51[c] | .26[c] | .16[c] | .08[c] | .01[c] | .01[c] | .00[c] | .00[c] |
| V | .00[c] | .00[c] | .00[c] | .00[c] | .00[c] | .00[c] | .00[c] | .00[c] |

a. Male HSG/HSSR only.
b. All accessions in a given year do not necessarily come from that year's applicants because some applicants are placed in delayed entry programs.
c. The declining ratio is taken as an indication that individuals in that category are not actively recruited.

## RESULTS

The recruiting product (that is, the ratio of accessions to population, taken from table 2) produced by the undifferentiated effort is summarized in table 5. For example, the data indicate that 2.1 percent of the population of male high school graduates age 17 to 21 in AFQT category I were enlisted in 1980. This may be contrasted with a 3.6 percent rate for category IIIA in that year.

In 1987 the percentage by AFQT category ranged from 1.8 to 6.0 percent.[1] At first glance, this seems like a very small fraction and might lead one to conclude that recruiters do not actively recruit but function as "ordertakers." If this were the case, it might imply a goal-driven outcome and weaken the assumptions on which this analysis is based. However, the percentage of population accessed is more properly multiplied by a factor of 5 because the population base is a five-year age group while accessions must be produced each year. Viewed in this light recruiters are expected to enlist about 9 percent of category I male HSGs and 30 percent of category IIIB from each graduating class. With this perspective, the process is reasonably seen as more nearly supply-limited and less goal-driven.

1. The actual population of youth has declined somewhat between 1980 and 1987. Because absolute numbers are not central to the discussion, the population figures for 1980 are used throughout the period.

Table 5. Ratio of DOD accessions[a] to population[b] by AFQT category

| AFQT category | Fiscal year 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|---|---|---|
| I | .021 | .012 | .012 | .014 | .016 | .018 | .016 | .018 |
| II | .023 | .032 | .035 | .038 | .042 | .035 | .038 | .038 |
| IIIA | .036 | .044 | .045 | .052 | .058 | .050 | .056 | .057 |
| IIIB | .035 | .043 | .046 | .051 | .057 | .064 | .073 | .060 |
| IVA | .058 | - | - | - | - | - | - | - |

a. Male HSG/HSSR only.
b. Male HSG only.

The relative average recruiting yield is taken as the inverse of the recruiting product in table 5 scaled to the yield in AFQT category IIIA. The resulting estimates of relative yields are shown in table 6. For example, the data indicate that in 1980, the relative yield for category I male HSG was 0.58, compared to category IIIA male HSG. Put differently, if recruiters were attempting to enlist recruits from a population of 1,000 category I male HSGs, they would expect to access 21. From a population of 1,000 category IIIA male HSGs, they would expect to access 36. Therefore, the relative yield for category I is 21/36, or 0.58. The estimates of relative yields are generally stable across years and are averaged in the last column of table 6. These averages are taken as the best estimates of relative average DOD recruiting yields by AFQT category.

Table 6. Relative average DOD recruiting yields[a] by AFQT category and year

| AFQT category | Fiscal year 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | Mean |
|---|---|---|---|---|---|---|---|---|---|
| I | .58[b] | .27 | .27 | .27 | .28 | .36 | .29 | .32 | .31 |
| II | .64 | .72 | .78 | .73 | .72 | .70 | .68 | .67 | .70 |
| IIIA | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| IIIB | 0.97 | .98 | 1.02 | .98 | .98 | 1.28 | 1.30 | 1.05 | 1.05 |
| IVA | 1.61 | -- | -- | -- | -- | -- | -- | -- | 1.61 |

a. Male HSG/HSSR only.
b. Probable anomalous result due to poorly determined AFQT conversion table for ASVAB forms 6 and 7 in the upper percentiles [8].

The estimates of relative average recruiting yields are compared to the relative aptitudes of the target population groups in table 7. The data indicate, for example, that the mean AFQT percentile in AFQT category I is 96.5, which is 1.6 standard deviations above the mean of the population. Male HSGs in this category are estimated to have a population yield that is only 31 percent of those in category IIIA.

Table 7. Relative average recruiting yield by recruit aptitude level

| AFQT category | AFQT percentile | | Standard deviation of mean percentile from population mean[a] | Relative average recruiting yield |
|---|---|---|---|---|
| | Range | Mean | | |
| I | 93-99 | 96.5 | +1.6 | .31 |
| II | 65-92 | 79.5 | +1.0 | .70 |
| IIIA | 50-64 | 57.0 | +0.2 | 1.00 |
| IIIB | 31-49 | 40.0 | -0.3 | 1.05 |
| IVA | 21-30 | 25.0 | -0.8 | 1.61 |

a. (Mean AFQT percentile - 50.0)/28.9.

Viewed in the context of table 7, the results do not seem unreasonable. Individuals slightly above or slightly below mean aptitude are just as likely to enlist. The recruiting yield at about one standard deviation above the mean aptitude is 30 percent lower than that at the mean, whereas the yield in category IVA, which is nearly one standard deviation below the mean, is 60 percent higher.

The results in tables 5 and 6 are expressed in recruits per population. Another way of interpreting the findings is to calculate the size of the population necessary to recruit a given number of accessions in an AFQT category. For example, from table 5 it can be estimated that 57 recruits would be expected from a population of 1,000 category IIIA male HSGs. To get the same number of accessions from category I, the population needs to be 3,167, or 3.17 times larger. This approach provides a rough estimate of the relative difficulty of recruiting in the highest AFQT category.

It must be stressed that this analysis is based on the assumption of undifferentiated recruiter yield--an assumption that seems reasonable and is supported by the analysis. However, the analysis also indicates a substantial benefit could be gained if some way could be found to differentiate recruiter efforts more accurately and thereby enhance the ability of the services to recruit upper-mental-group individuals.

## EXTENSION OF THE RESULTS

The results presented in table 7 are given in smaller intervals than has generally been possible and should be useful as is. However, estimates for even smaller intervals of aptitude would be most useful to the job performance project. These could easily be done. The procedure described here is only limited by the sample size available in the reference population base. The existing base (approximately 2,000 cases) should support calculations in intervals of 10 percentile points. Applicant data from the years 1976 through 1980 would be particularly appropriate for addressing yields of low aptitude personnel. Individual services will, of course, have different aptitude ranges where the essential assumptions hold and may have different relative yields. It may also be possible to use these results to calculate recruiting costs for different aptitude mixes, although this requires making some assumptions about the effectiveness of recruiters.

Another potentially valuable extension of this analysis would be to use these results to calculate recruiting costs for different aptitude mixes. This requires making some assumptions about the effectiveness of recruiters, but may provide more useful information than estimates based on the traditional econometric approaches. For example, if recruiters were able to differentiate among individuals with different aptitudes, a rough appoximation of the relative cost of recruiting an individual in AFQT category I versus category IIIA would be the reciprocal of the recruiting yield of 0.31 shown in table 6. This gives an estimated relative cost of 3.23, which is likely to be a slight underestimate of the true cost because it assumes that recruiters are able to differentiate among applicants of different abilities, and this is unlikely to always be true. Further refinements could be made by outlining more explicitly the way in which recruiters operate, and how that relates to the various yields estimated in this paper. Additional research along these lines would make a significant improvement in the estimation of the relative costs of recruiting different aptitude mixes.

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[8] CNA Study 1152, *A Reexamination of the Normalization of the Armed Services Vocational Aptitude Battery (ASVAB) Forms 6, 7, 6E, and 7E*, by W. Sims and A. Truss, Apr 1980 (07115200)

[9] Office of the Secretary of Defense (Directorate for Accession Policy), Technical Memorandum 80-1, *Renorming ASVAB 6/7 at Armed Forces Examining and Entrance Stations*, by M. Maier and F. Grafton, Aug 1980


1. The numbers in parentheses are internal CNA control numbers.

# APPENDIX A

# SUPPLEMENTAL DATA

## APPENDIX A

## SUPPLEMENTAL DATA

Table A-1 tabulates the distribution of male high school graduates ages 17 to 21 in the reference population by AFQT category. The sample size of 1,762 cases is modest but probably satisfactory, and it corresponds to the traditional age grouping used by manpower planners. The AFQT distribution of the larger sample, age 17 to 23, is shown to be similar, increasing confidence in the stability of the results.

**Table A-1.** Distribution of male high school graduates in population[a] by AFQT category

| | Percentage | | Number of cases | |
|---|---|---|---|---|
| AFQT category | Age 17-21 | Age 17-23 | Age 17-21 | Age 17-23 |
| I | 10.5 | 13.1 | 133 | 283 |
| II | 35.4 | 37.3 | 514 | 933 |
| IIIA | 15.5 | 14.3 | 257 | 414 |
| IIIB | 18.9 | 16.9 | 362 | 555 |
| IVA | 7.2 | 6.9 | 172 | 267 |
| IVB/C | 8.0 | 7.3 | 185 | 289 |
| V | 4.5 | 4.2 | 139 | 200 |
| Total | 100.0 | 100.0 | 1,762 | 2,941 |

a. 1980 Reference Population.